channel unit utilization in a discovery response.[1] Nevertheless, the final input sheets prepared by headquarters show 80% utilization[2] and the change at headquarters' instance is unexplained. AT&T adds that Rochester Telephone's study uses a 100% utilization factor, thereby corroborating the higher figure. AT&T's sensitivity analysis suggests that changing the channel unit utilization from 80% to 95% would reduce New York Telephone's loop cost by 62¢ per month.

New York Telephone responds that this situation exemplifies the proper role of headquarters subject matter experts, noting Mr. Gansert's testimony[3] that a network cannot be run efficiently with 95% utilization of channel units. It attributes its field engineers' use of 95% to terminological confusion, such as whether a channel unit should be considered "utilized" if any one of its four links is connected or only if all four are occupied. With regard to the broader issue to which this points, New York Telephone contends that "the argument that the 80% number is somehow 'unsupported' because it does not match initial data supplied by the field is meaningless. The number was disclosed, justified, and explored on cross-examination and is fully supported in the record."[4]

ii. <u>NID Utilization</u>

New York Telephone used a 60% utilization factor for Network Interface Devices (NIDs).[5] AT&T regards this as

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1 Exhibit 139, ATT-NYT-54, (This exhibit was initially marked proprietary at New York Telephone's request; the request has since been withdrawn.)

2 November 8 Documents (Exhibit 224), Attachment H.

3 Tr. 3,310.

4 New York Telephone's Reply Brief, pp. 12-13, citing Tr. 2,463-2,464 and 3,309-3,312.

5 A NID is a small connection block, installed on the customer's side of the network protector, to which the customer connects its inside wire.

"preposterous,"[1] for it implies that even though the actual installed cost of a two-line NID is $48.80, the required NID investment for a home with two lines would be $81.34 (that is, $48.80 ÷ .6). It maintains as well that New York Telephone further overstates its investment by treating a two-line NID as applicable to all lines in its study. AT&T's sensitivity study calculates that use of an 80% utilization factor for NIDs, which it regards as appropriate, would reduce the loop costs by 40¢ per month.

New York Telephone responds that it uses a two-line NID even in one-line households as a prudent, cost-minimizing measure to avoid a separate service call if a second line is installed. The average number of lines per household is 1.2, and dividing that figure by two lines (the capacity of the NID) produces a utilization factor of 60%. Given a $48.80 investment for a two-line NID, the NID investment per line is $24.40, and applying the 60% utilization factor produces an NID investment per utilized line of $40.67. Multiplying that investment by 1.2 (the average number of lines per household) produces $48.80, the actual investment per NID. On that basis, New York Telephone asserts, there is no excess cost recovery.

iii. Feeder

AT&T sees no record support for New York Telephone's 65% fill factor for copper feeder, noting Mr. Gansert's testimony that "normal feeder plant runs at an 85% fill."[2] AT&T's sensitivity analysis shows that using what it regards as a conservative fill factor of 75% reduces the loop cost by 12¢ per month.

With respect to fiber feeder, AT&T alleges that New York Telephone's fill factors of 56% to 68% would result in oversized facilities to accommodate not only future growth but

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[1] AT&T's Initial Brief, p. 83.

[2] Tr. 3,310 (New York Telephone witness Gansert).

also broadband service demand, the costs of which should not be borne by New York Telephone's competitors. Its sensitivity analysis shows that using what it regards as proper fill factors of 50% to 75% reduces loop costs by 9¢ per month.

New York Telephone responds that the 85% factor referred to by Mr. Gansert is an objective fill factor, not the average fill factor used in New York Telephone's studies.[1]

iv. <u>Copper Distribution Lines</u>

AT&T alleges that the input sheets provided by New York Telephone's field managers show utilization factors of 70%-80% for copper distribution lines rather than the 40% used in New York Telephone's study, and it adds that the BCM-2 cost model has raised distribution plant fill factors toward the Hatfield model levels of 50%-75%. MFS suggests that the appropriate factor is 65%, the level initially recommended by New York Telephone's central engineering staff in distributing the data templates to its field managers. AT&T's sensitivity study suggests an associated reduction in loop costs of $1.71 per month.

New York Telephone responds that its 40% estimate is based on the serving area concept that governs the deployment of distribution plant, under which loop plant for a new serving area is made large enough to serve every potential household in the area with two lines even if the area is not yet fully occupied. New York Telephone believes it is cost effective to avoid subsequent installation costs in this way.

v. <u>Conduit</u>

AT&T witness Globerson, whom New York Telephone did not cross-examine, sought to show that New York Telephone's conduit utilization factor of 60% was equivalent, when factors such as the use of only two of the three inner ducts in any given duct (a measure intended to provide a path for replacement cable if necessary) are taken into account, to an effective utilization of

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[1] Tr. 3,466-3,468.

only 24%. AT&T's sensitivity study shows that using an appropriate input of 80% utilization would reduce costs by 59¢ per month.

New York Telephone responds, in brief, that Mr. Globerson overstated his case and that the empty duct per conduit is a necessary design criterion.

2. The Hatfield Model

To estimate demand, the Hatfield Model's first module starts with data regarding each state's census block groups, each of which is assumed to be served from the nearest existing wire center of the incumbent LEC. Through a variety of calculations, which take account as well of access line and usage demand data reported by New York Telephone, the model determines the number of residential, business, special access, and public lines in each CBG. In its next module, the model uses the distance between each CBG and its serving wire center, as well as topographical considerations, to estimate feeder and distribution cable lengths. It does so on the basis of a variety of assumptions, such as the existence of four main feeder routes leaving each wire center, with subfeeder routes placed at 90-degree angles from the main feeder routes, and the uniform spacing of customer premises across a CBG. On the basis of geometric relationships, it calculates average distribution distance within a CBG to equal five-eighths of the length of one side of the CBG.[1]

To estimate switching, signalling, and transport investment, the model's wire center investment module uses the total line counts for each wire center along with data on inter-office distances and the distribution of total traffic among varying services as well assumptions regarding traffic. On

[1] These are but a few examples of the model's many assumptions and calculation techniques. The model's proponents generally cite them as evidence of the model's sophistication and accuracy while its opponents say they exemplify its arbitrariness or excessive complexity.

that basis, it calculates such items as the size of the switches to be placed in each wire center and the amount of trunk capacity needed.[1]

Many of the assumptions incorporated in the model can be varied by the user; the model assigns default values for those assumptions. Fill factors are among those assumptions, and they are specified for each of six density zones identified by the model.[2] For feeders, the default fill factors range from 65% in the lowest density zone to 80% in the four highest density zones; for distribution lines, the fill factor starts at 50% in the lowest density zone and increases by five percentage points to a maximum of 75% in the highest density zone. The default fill factors are based on "experience and conversations with various vendors, carriers, both [inter-exchange carrier] and LEC, telecommunications consultants and other industry experts over the past 20 years."[3]

New York Telephone challenges various aspects of the Hatfield Model's operation in these areas. It contends, to begin, that census block groups are poor approximators of local serving areas, placing houses and businesses where they do not exist and causing numerous gross distortions and miscalculations. Similarly, Time Warner sees no basis for the model's estimation of the number of business lines in a CBG on the basis of the number of employees.

New York Telephone goes on to challenge the assumptions used to estimate the structure required within each CBG, claiming to have shown through cross-examination of AT&T's witness Floyd

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1 This description of the model will be continued below, in the context of the inputs to which the remaining modules correspond.

2 Density zones are determined on the basis of lines per square mile. They are defined as less than five; five to 200; 200 to 650; 650 to 850; 850-2,550; and greater than 2,550. Density zones are discussed further in the consideration of geographic deaveraging, below.

3 Exhibit 142, MCI's response to information request NYT-MCI-26.

that the simplifying assumptions provided insufficient cable length and sized the cable incorrectly. It recognizes that in acknowledging these mistakes, AT&T's witness asserted that the hypothetical on which they were based was "extreme," but it asserts these problems are endemic and reflect flaws in the model that cannot be corrected simply by adjusting input values. New York Telephone challenges as well the adequacy of the 20% factor added by the model to calculated cable lengths in geographic areas identified as rocky, contending that it does not account for obstructions that may exist in the real world. It questions a variety of other assumptions made by the model, including its failure to recognize cable length for running feeder up into high rise buildings (even though New York Telephone is responsible for those costs in many such buildings and vertical distances in New York City may exceed the horizontal distance from a wire center to a building), as well as its assumption that no manholes will ever be required in the distribution plant, even though 30% of distribution is assumed to be underground in high-density areas. It also challenges the assumption that one serving area interface (SAI) will be needed in each CBG, even though the model calls for over 50,000 lines to be cross connected at one such SAI. It denies so large an SAI actually exists and notes MCI's acknowledgement that the model does not estimate the cost for any SAI larger than 3,600 lines.[1]

New York Telephone asserts further that the model omits some of the facilities required at wire centers, such as the channel banks or multiplexers needed for the interface between unswitched lines carried over copper loops and the inter-office transport system as the Hatfield model contemplates it.[2] Similarly, New York Telephone contends that the model does not allow for an adequate number of fiber optic terminations, for it calculates the number of fiber optic terminations on the basis of

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1 New York Telephone's Initial Brief, p. 90.

2 Ibid., p. 91.

the number of trunks per line required at a given wire center, thereby failing to take account of the need for interoffice facilities to handle "through traffic" at any given wire center. It offers a detailed example of this alleged inadequacy and suggests that engineering errors such as this help explain the difference between Hatfield's $281 million figure for common and dedicated transport costs and New York Telephone's $875.1 million estimate for dedicated transport costs alone.[1]

With respect to fill factors, New York Telephone asserts that the Hatfield model takes account only of the maximum fill that would lead to a decision to add capacity, relying upon the modularity of cables and other elements to incorporate some additional capacity.[2] It does not take account, however, of the additional capacity required for the planning horizon and, according to New York Telephone, thereby understates costs. Moreover, the model estimates cable needs on the basis of current customers and not on the basis of the more efficient "serving area" concept described above. New York Telephone adds that neither AT&T nor MCI justified the use, as default inputs, of distribution fill factors higher than those used in BCM-1, on which the Hatfield model was built. As noted, the Hatfield default values range from 50% to 75% depending on density zone; the BCM values range from 25% to 75%, increasing by ten percentage points from density zone to density zone.

AT&T and MCI respond to New York Telephone's criticisms. They contend, among other things, that the CBG building block method does provide a reasonable representation of the real world, noting that New York Telephone's hypothetical to the contrary relates, on a worst-case basis, to an extreme

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[1] Ibid., pp. 93-94.

[2] For example, an area requiring 110 cable pairs with a fill factor of 50% would require a cable providing 220 pairs. But cables do not come in every size imaginable, and that situation would require use of a 400 pair cable, resulting in an effective fill factor of 110/400 = 27.5%. (AT&T's Initial Brief, p. 132.)

situation and ignores off-setting circumstances where the Hatfield Model provides more facilities than required. AT&T adds that "as costing models--not construction models--neither the Hatfield model nor any of the recognized forward-looking costing models is designed to engineer actual loop lengths for every possible individual case, however extreme."[1] The model recognizes difficult terrain, they go on, by always assuming right angle routing between any two points rather than calculating routing as the bird flies, thereby increasing cable lengths. The 20% add-on referred to by New York Telephone provides for additional cable length in particularly difficult situations, and AT&T cites the advice of Mr. John Donovan, a telecommunications consultant working with Hatfield, that the 20% terrain factor was "generous."[2] As for the omission of vertical cable in high rise buildings, AT&T contends that New York Telephone's own documents confirm Hatfield's assumption that feeder cable terminates in the basements of Manhattan buildings,[3] while MCI notes that New York Telephone is offering House and Riser Cable Service as a separate unbundled element. As for Hatfield's assumption of no manholes for distribution plant, AT&T maintains New York Telephone introduced no evidence to show this approach invalid and that, in any case, the assumption has been shown to be "fundamentally sound."[4]

AT&T acknowledges the error of assuming only a single SAI for each census block group, but contends that correcting the error would increase the monthly cost for an unbundled loop by

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1 AT&T's Reply Brief, p. 93.

2 Mr. Donovan is a former New York Telephone employee with approximately 24 years of service and "extensive hands-on outside plant engineering experience throughout New York," whose advice provided the basis for various Hatfield model default inputs. (AT&T's Reply Brief, p. 94.)

3 Ibid., p. 95; Tr. 2,754-2,755.

4 AT&T's Reply Brief, pp. 96-97, citing Exhibit 143, information request NYT-ATT-212.

only three-tenths of one cent. It maintains the error does not suggest any methodological shortcoming and confirms that the model is an open one that can be analyzed in depth and tested.[1]

With regard to the omitted multiplexers, MCI notes that Hatfield assumes, on the basis of planned offerings by at least one vendor, that the need for this equipment will be eliminated in the future and that, in any event, New York Telephone has not estimated the per-line costs of the alleged omission. MCI acknowledges New York Telephone's point that the model does not provide adequate facilities for through traffic but asserts that the model assumes no such traffic and that, if New York Telephone is suggesting that a more efficient network design would contemplate through traffic, the network design assumed by Hatfield would thereby <u>overstate</u> the cost of interoffice facilities.[2] AT&T asserts that New York Telephone has raised only a theoretical argument but has shown no actual need for the omitted equipment, some of which is simply not needed in the network contemplated by Hatfield.[3]

Finally, with regard to fill factors, AT&T contends the record shows its fill factors are consistent with industry practice, and it points to evidence that New York Telephone's actual distribution utilization is higher than that reported by its engineering witness Gansert. And while New York Telephone compared the Hatfield fill factors to those in BCM-1, the factors used in BCM-2 (a cost model developed and sponsored by U. S. West and Sprint) are closer to Hatfield's in density zones one through three, and are equal to or even higher than Hatfield's in the three most dense zones. On that basis, AT&T contends that Hatfield's approach for distribution plant "has received

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1 AT&T's Reply Brief, pp. 97-98.

2 MCI's Reply Brief, p. 11.

3 AT&T's Reply Brief, pp. 106-110.

independent confirmation within the telecommunications industry."[1]

3. Discussion

Though demand is in some sense an input, the models' methods for estimating it are among their fundamental defining qualities and are considered further in the "General Issues" section of the opinion. For present purposes, no adjustment will be made to either model.

Relatedly, New York Telephone has identified several potential shortfalls in the Hatfield Model's projections of needed equipment, and the Hatfield proponents have been less than fully effective in responding. Here again, no adjustment will be made, but we see this as an area of likely weakness for the Hatfield model.

With respect to fill factors, New York Telephone has effectively countered the allegations that it double counted in its projection of demand and its use of fill factors. It simply took plant augmentation concepts into account in determining the amount of plant needed to meet the contemplated demand. Nevertheless, several adjustments to New York Telephone's specific fill factors are warranted.

For channel units, Mr. Gansert testified that a network cannot be run efficiently with 95% utilization. Moreover, New York Telephone's 1996 construction budget, as filed with us, shows a utilization factor of only 60%. New York Telephone's 80% is a reasonable utilization factor for channels.

For fiber feeder, the capacity of fiber in general is limited only by the capacity of the electronics that derive communications channels from it. In these circumstances, the channel unit fill can be used as a surrogate for fiber feeder utilization; a factor of 80%, rather than New York Telephone's 56% to 68%, will be applied.

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[1] Ibid., p. 104.

Finally, for distribution cable, the 1996 construction budget shows actual utilization of about 60%, in contrast to New York Telephone's proposed 40%. We will use a factor of 50%, recognizing that some of the cable pairs in the budget are carrier derived pairs. That 50% figure gains added support from the approximately 52% effective fill figure used in the Hatfield Model.

The foregoing fill factors have been used in re-running both the Hatfield Model and New York Telephone's study.

System Investment

Each model defines the technological nature of the system to be installed to meet the contemplated demand and estimates the costs to be incurred in building that system. This section of the opinion treats the issues raised by the parties' challenges to each other's treatment of these matters.

1. New York Telephone's Model

The method used by New York Telephone to calculate investment for each network element at issue is set forth at length in its initial brief. Highlights of its approach will be briefly summarized here; additional details will be provided, as needed, in the context of describing the other parties' challenges.

a. Summary of New York Telephone's Approach

i. Loops

New York Telephone employed an engineering approach, one of three methods permitted by the Loop Cost Manual. It assumed use of digital loop carrier (DLC) technology, which involves the use of fiber optic cable, rather than the alternative of carrying analog electrical signals end-to-end on copper cable. According to New York Telephone, "it has been generally recognized that DLC technology provides the most efficient technology for provisioning loops."[1] It maintains that its use of DLC technology in newly deployed feeder plant is supported by cost/benefit analyses.

DLC loops can interface with a digital switch via "integrated" or via "universal" technology. New York Telephone's model contemplated ubiquitous deployment of integrated DLC (IDLC) technology, implying that, with limited exceptions, all feeder plant used optical fiber rather than copper.

New York Telephone's model followed existing feeder and distribution routes as well as existing structure architecture. ("Structures" refer to facilities that physically support or protect the cable, such as poles and conduit.) These routes, based on various guidelines that had been developed by the Bell System, are said by New York Telephone to be "the shortest and most economical routes given the actual obstacles encountered, and any other methods use[d] to 'estimate' or 'calculate' loop routes and lengths will produce unrealistic and inaccurate results."[2] On that basis, New York Telephone modeled 100% fiber links in high-demand, high-density zones and hybrid fiber/copper links elsewhere.

With regard to structure investment, New York Telephone assumed that outside facilities currently overhead and currently underground would remain so; it considered this conservative inasmuch as a forward-looking engineering design would likely entail the construction of a greater percentage of more costly underground facilities. It recognized joint ownership of utility poles with other utility companies by taking account of only that portion of the structure investment owned by New York Telephone; that factor is approximately 50% overall.

To determine the cost of materials and installation, New York Telephone used the most current vendor material and

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1 New York Telephone's Initial Brief, p. 52, citing Tr. 3,182-3,184 for its witness Gansert's explanation of why optical fiber is more efficient than copper.

2 New York Telephone's Initial Brief, p. 54.

installation prices, reflecting the latest vendor discounts it had realized. The data were derived from two systems used by New York Telephone, the outside plant planners costing tool (the costing tool) and the engineering and construction records information system (ECRIS).

ii. Local Switching

New York Telephone's model contemplated digital switching as the forward-looking technology. Ports (the component of the switch that terminates lines and trunks) are assumed for the most part to provide digital interface capability.

To determine local switching investment, New York Telephone used Bellcore's switching cost information system (SCIS) model along with various other necessary inputs.[1]

iii. ISDN

New York Telephone separately treated the loop and local switching issues presented by Integrated Services Digital Network (ISDN) service. That is an advanced technology that permits end-to-end transmission of signals in digital format, avoiding any need for analog transmission and thereby, among other things, obviating modems at customer premises and supporting higher speed data transmission than can be achieved on analog telephone lines.

ISDN is offered in two formats: the lower capacity Basic Rate, and the higher capacity Primary Rate. Basic Rate, at present, is more efficiently provided (for loops under 18,000 feet) on copper than on fiber. Nevertheless, in view of the fiber-based system as a whole projected by New York Telephone, it included the additional equipment needed to meld Basic ISDN with fiber. It saw this as warranted to avoid imposing on all customers the added costs (i.e., those associated with introducing some copper into the forward-looking fiber network)

[1] Ibid., pp. 65-67.

simply to support lower rates for the much smaller number of ISDN customers.

### iv. Tandem Switching

Tandem switches are used to collect demand from many locations and concentrate it to create efficiently loaded trunk groups. New York Telephone's model assumed that only #5ESS digital switches would be used as tandems, consistent with its engineering department's latest designs.

### v. Interoffice Transport

All new transport systems being deployed by New York Telephone conform to the synchronous optical network (SONET) standard applicable to high capacity fiber optic systems. The investments for interoffice transport were estimated using the same methods as those applied to loop components. The utilization factor was 50%, the mid-point of the 25% to 75% range that now characterizes SONET equipment utilization in New York. Company witness Gansert recognized that this factor was lower than that for the existing, asynchronous network, noting that SONET reinforcement jobs usually provide a four-fold rather than a two-fold increase in network capacity.[1]

### vi. Signalling Systems

Signalling information is transmitted over paths separate from those used to transmit voice traffic. The system comprises signalling transfer points (STPs), at which signalling information is switched; signalling links, which carry the information between STPs and local and tandem switches; and service control points (SCPs), databases in which information used by the signalling network is stored. STP costs were modeled using New York Telephone's engineering department's latest designs and assumed placement of STPs at existing locations.

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[1] Ibid., pp. 75-76, citing Tr. 3,158-3,159.

STPs and SCPs were not calculated by density zone, on the premise that the relevant costs were not density sensitive.

b. Critiques

i. System Configuration

AT&T criticizes New York Telephone for taking as a given not only the present locations of its existing wire centers as contemplated by the FCC, but also the location of other components of its current network, such as existing feeder and distribution routes. It asserts this reflects the embedded approach rejected by the FCC in its TELRIC guidelines rather than the reconstructed local network mandated by the FCC. It sees no evidence in support of New York Telephone's argument that its current plant design is the most efficient, suggesting that it reflects decisions made over the course of decades, often reflecting short-term factors and turning out in the long run to be wrong.

New York Telephone responds that there is no evidence that its current routings are inefficient and notes that the Massachusetts DPU accepted the principle of relying on existing network layout and topology.[1]

ii. Equipment; Fiber v. Copper

Several parties maintain that New York Telephone's use of DLC technology and mostly fiber feeder cable provides a high-capacity broadband network beyond what is needed to provide basic telephone service. These parties attribute this decision to New York Telephone's business strategy, evidenced by public documents in the record,[2] of putting in place a broadband network for the provision of future services, including video as well as telecommunications, and argue that while New York Telephone is entitled to do so, the costs should not be imposed on competitors

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[1] Massachusetts Order, pp. 13-14, quoted at New York Telephone's Initial Brief, p. 55, n. 76.

[2] MCI cites Exhibits 151-154. (MCI's Initial Brief, p. 19.)

wishing to purchase the unbundled networks needed to provide basic telephone service. New York Telephone's basic position is that the digital, fiber system it projects is also the most cost-effective means of providing narrowband service. MFS sees an anomaly in the implication that New York Telephone's opponents would have it use a less efficient system, thereby inflating the costs they themselves will be called upon to pay, and it counsels skepticism with regard to New York Telephone's suggestion that it understands its competitors' economic interests better than they themselves do.[1]

With respect, first, to fiber optic feeder, AT&T attributes New York Telephone's decision to use all-fiber feeder to its interest in accommodating broadband services. Maintaining that copper is cheaper than fiber for relatively short loops (the point at which the use of fiber becomes more economic is referred to as the "crossover point"), AT&T asserts that the typical crossover point nationwide ranges between 9,000 feet (the point used in the Hatfield model) and 12,000 feet[2] and that New York Telephone has failed to identify any other regional Bell operating company that has taken the position that zero copper feeder is the most economical way to provision a local network. AT&T asserts that New York Telephone's model does not permit the user to vary its assumption of all-fiber feeder but that a modification to the study that included copper feeder under 9,000 feet and made a methodological change necessary to do so suggested that adoption of a crossover point of 9,000 feet would reduce New York Telephone's loop cost by about $3.00 per month.

Arguing in a similar vein, MFS contends that New York Telephone's theoretical network departs, without explanation, from the Bellcore carrier serving area (CSA) standard, which

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1 MFS' Reply Brief, p. 13.

2 It cites cross-over points of 12,000 feet for Pacific Bell (by order of the California Commission, Pacific Bell having proposed 9,000 feet), Bell South, GT&E, and Southern New England Telephone, and 16,000 feet for U.S. West.

"holds that links shorter than [12,000 feet] may be provisioned over less costly copper plant without any disruption to narrowband voice and digital services."[1] It cites in this regard the decision, also noted by AT&T, in which Pacific Bell had proposed a theoretical network for costing universal service that used a 9,000 feet crossover and in which the California Commission raised the crossover to 12,000 feet.[2] MFS particularly objects to the use of fiber in Manhattan, saying it diminishes the savings associated with short loop lengths in Manhattan. More broadly, MFS contends New York Telephone's study contemplates a "broadband-ready" network, in its use of fiber and DLC, which has been limited to narrowband capacity. This, it says, is consistent with New York Telephone's actual plans but not with the TELRIC concept of an efficient narrowband system.

AT&T also challenges New York Telephone's use of DLC equipment, asserting an absence of record evidence regarding the basis for New York Telephone's selection of the mix of DLC equipment used in its cost study and contending that materials produced after the hearing "confirm that the field's inputs were rejected."[3] It alleges that New York Telephone's actions "are facially reflective of an intentional and unreasonable inflating of loop costs."[4] It suggests that a conservative change in the mix of DLC equipment would cause monthly loop costs to drop by 84¢.

New York Telephone responds that its use of fiber does not imply a broadband construct, asserting that fiber in the loop is necessary but not sufficient to support broadband and that the significant cost difference between broadband and narrowband systems depends not on whether fiber or copper is used but on the optics and electronics installed at the terminals of the system,

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1 MFS' Initial Brief, pp. 12-13.

2 Ibid., pp. 13-14.

3 AT&T's Initial Brief, p. 81.

4 Ibid., pp. 81-82.

and that the equipment used for those purposes in New York Telephone's model is specifically designed for basic telephone service. It adds that it is inconsistent to suggest that fiber feeder is appropriate for basic service above the crossover point but at shorter lengths implies a broadband system. The crossover points used by other companies are not pertinent, New York Telephone continues, inasmuch as they reflect substantial amounts of embedded copper-driven investment, the need for which would be eliminated in connection with a forward-looking new system; and AT&T has provided none of the needed context to understand the crossover points used by other companies. For example, it says, examination of the SNET practice cited by AT&T shows numerous reasons why it does not support a 9,000 foot cutover point in New York in 1997, among them that the study was conducted in May 1983. Finally, New York Telephone argues the CSA standard is part of a document, entitled "Notes on LEC Networks," that is descriptive rather than prescriptive and that focuses on transmission, not economic, characteristics of networks, and the standard cited is a transmission standard setting the maximum loop length that is allowed to achieve certain transmission characteristics.[1] New York Telephone also asserts that AT&T's sensitivity analysis is flawed, in part by its reference to the Hatfield Model and by its failure to change all relevant network characteristics that would be affected by adopting the cutover point it suggests. It offers its own sensitivity analysis, which purports to show that assuming 100% copper cable in the major cities density area in fact raises the cost of a loop rather than reducing it.[2]

On a more theoretical plane, New York Telephone argues that even if its deployment of IDLC were justified in part by its desire to provide broadband, the FCC's element-oriented TELRIC approach obviates consideration of how element costs should be

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1 New York Telephone's Reply Brief, pp. 26-34.

2 Ibid., p. 35.

allocated to particular services, such as those provided over broadband and those provided over narrowband. As support for this view, it cites staff's rejection, in a memorandum to the Commission regarding the Loop Cost Manual, of the view, then advanced by the Consumer Protection Board, that the pertinent costs initially were those of a "basic" loop capable of providing only voice-grade service. This memo stated that "the plant investment is used to provide a myriad of services at a level of service quality which meets the Commission's objectives. It would be irrelevant and perhaps impossible to develop a loop cost for a 'minimum' grade of voice service based on a previous technology that was capable of providing only basic voice grade service."[1] New York Telephone also cites a paper by Alfred E. Kahn and William B. Shew, assertedly showing why the marginal cost of a telecommunications service must be calculated as the marginal cost of providing that service on a network optimized to provide all of the services demanded by the carrier's customers. According to that paper, separate costs should not be determined for a particular customer on the basis of the hypothetical costs of a network optimized to provide only the services demanded by that customer.

AT&T responds that New York Telephone has mischaracterized the FCC's approach, which still requires properly identifying the services that make up the total increment of demand. Moreover, it says New York Telephone has misstated the point of the Kahn and Shew article, which dealt with how to determine the economic efficiency of building a network to accommodate future broadband needs, but neither presumed, without evidence of efficiency, that such a network should be built nor spoke to the issue, noted as a concern, of pricing narrowband services above their stand-alone costs. It cites a recent article in which Dr. Kahn objects to assigning to basic service customers any more of the revenues from enhanced

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[1] Staff memorandum to the Commission, March 8, 1995, quoted at New York Telephone's Initial Brief, pp. 57-58.

services than needed to insure that basic services are not priced above stand-alone costs, and it suggests this objection to cross-subsidies would apply to those running the other way as well.[1]

iii. Material and Installation Prices

Several parties challenge New York Telephone's reliance on its most recently available actual prices for various inputs. MCI contrasts what it calls these "exceptionally high" prices with the TELRIC requirement that "the lowest available" prices be used[2]. MFS sees a clash with the TELRIC requirement of a forward-looking analysis, which it believes could have been satisfied by a formal survey of market prices, as by averaging vendor quotes; it suggests that would have been easy to do in view of Mr. Gansert's stated on-going monitoring of the technology market. AT&T and MCI criticize New York Telephone for failing to project continuation of the substantial discounts it has been able to achieve in its purchases of digital switching equipment; MCI notes this results in incremental switching costs substantially in excess of embedded.

New York Telephone responds that no party has done more than suggest inefficiencies in New York Telephone's past practice, and that no one has identified particular adjustments that might be warranted. It doubts hypothetical bids of the sort contemplated by MFS would be more instructive than actual current prices. It attributes the substantial discounts it received on switch prices to the switches having been purchased as part of its program to replace analog switches with digital. Vendors are willing, it says, to offer discounts in connection with such programs (to encourage upgrades that create a market for new software), but the program is nearly complete and the discounts are unlikely to continue.

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[1] AT&T's Reply Brief, pp. 15-19.

[2] MCI's Initial Brief, p. 20.

New York Telephone also notes, in this connection, that the Massachusetts DPU found "no reason to believe that the [SCIS] model does not produce reasonable outputs" with respect to switching costs.[1] AT&T responds that, in the ensuing paragraph, the Massachusetts Order agreed with AT&T that switching costs had been overstated by application of the SCIS model to inactive as well as active lines and directed New England Telephone to correct that input. (New York Telephone's study here appears free of this flaw.)

iv. <u>ISDN</u>

Finally, MFS challenges New York Telephone's use of DLC equipment to provide ISDN service, notwithstanding the assertedly general recognition that it is inefficient to do so.[2] It contends this is especially troublesome since New York Telephone will continue to serve its own ISDN customers over assertedly more efficient copper links. It asks that we "order [New York Telephone's] study to obey the CSA standard [described above] and thereby allow new entrants to access copper pairs for lines under 12,000 feet when voice <u>or</u> digital services are to be provisioned."[3] MFS asks as well that voice and digital two-wire links be priced alike; that all four-wire lines be priced alike (and in no event at more than twice the cost of two-wire links; and that we set rates for two types of digital lines (ADSL and HDSL) even though New York Telephone failed to refer to them in testimony. It notes the importance of these links to emerging competition and cites the statement, in its interconnection agreement with New York Telephone, that ADSL and HDSL will be priced in accordance with this proceeding's results.

New York Telephone responds that a disparity between the forward-looking model and actual provisioning practices is

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1 New York Telephone's Initial Brief, p. 65, n. 89.

2 MFS' Initial Brief, pp. 28-32.

3 <u>Ibid.</u>, p. 31 (emphasis in original).

not unique to ISDN and that in most cases New York Telephone will use embedded plant, thereby incurring higher costs, even though network element prices will be based on lower TELRIC investments.

2. The Hatfield Model

Here, too, we describe some representative highlights of the Hatfield model's process for determining element investments and then consider in more detail aspects specifically called into issue by other parties. As already noted, the model is fully described in Exhibits 138 and 164.

a. Highlights of the Model

The Hatfield model's "BCM-PLUS loop module" estimates loop cable facilities investment via a "'bottom-up' network design process that uses forward-looking loop plant engineering and planning practices, publicly-available information on component prices, and least-cost cable sizing algorithms to estimate the outside plant investment appropriate to a TELRIC-based analysis."[1] Recognizing that prices paid for loop components may vary from carrier to carrier, the model allows these values to be adjusted by the user but employs default values based on Hatfield's best estimates. As already noted, it assumes that fiber feeders would be used above a crossover point to be set by the user (the default value is 9,000 feet); for shorter feeder lengths, it assumes copper cable.

The model's wire center investment module produces investment estimates for, among other things, switching and wire centers, the signalling network, including STPs, SCPs, and signalling links, and transport investment. Here, too, many input assumptions are adjustable by the user but the model adopts default values. It places at least one end office switch in each wire center, taking, as its default value, a maximum effective

[1] Hatfield Model Description, p. 15.

switch line size of 80,000.[1] Once the switch is sized, the required investment per-line is calculated from an investment function relating per line investment to switch line size. The data defining the function are taken from a publicly available study of the central office equipment market published annually by McGraw-Hill. Those data are combined with information on carriers' average switch line sizes derived from an FCC publication, along with information on larger switches obtained from switch manufacturers, to develop the complete investment function.[2] The model uses existing tandem and end office wire center locations to compute interoffice transmission investments. To estimate tandem and operator tandem switching investments, the model relies on assumptions contained in an AT&T report on interexchange capacity expansion costs filed with the FCC.

In its convergence module, the model combines the loop cable investments with those for the other elements and produces the complete collection of network investments stated by density range. It permits the user to define inputs for conduit investment, pole investment and spacing, manhole investment and spacing, trenching and direct burial investment, and breakdowns of aerial, buried, and underground cable, though it sets default assumptions for each of these variables. The allocation of structure type among aerial, buried, and underground varies by density range; for example, with respect to fiber feeder, the default value in the lowest density range is 35% aerial, 60% buried, and 5% underground; in the highest density range it is 5% aerial, 5% buried, and 90% underground. With respect to distribution structure, the default value assumes 50% aerial, 50% buried and no underground in each of the first four density ranges; in the fifth density range it assumes 40% aerial, 50% buried, and 10% underground; and in the densest range it assumes 65% aerial, 5% buried, and 30% underground. It also provides a

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[1] This represents 100,000 lines with a fill factor of 80%.

[2] Hatfield Model Description, p. 25.

user defined input for the fraction of structure investment that should be assigned to local telephone service as distinct from other utility services (such as electric and cable television) that share poles, trenches, or conduits.

b. Critique

i. Copper vs. Fiber; System Design

As already noted, the Hatfield model used a 9,000-foot crossover point for fiber rather than copper in feeder lines. Noting that Hatfield had done no quantitative analyses to evaluate that figure, and had relied on observations of design practice in the industry, New York Telephone challenges the figure on the grounds that no effort had been made to validate it on the basis of an analysis of lifetime costs; that neither AT&T nor MCI, nor any other new entrant, planned to use copper feeder in any announced construction plans; that New York Telephone had decided nearly five years ago that copper feeder was not an economically efficient choice over the life of a link; and that Hatfield's consultant had testified in other proceedings that copper cable will be "obsolete in the very near future."[1]

In response, AT&T states that a crossover point of at least 9,000 feet "is universally accepted (except by NYNEX) within the telecommunications industry"[2]; that using all fiber for basic narrowband telephone service is an economically inefficient use of technology; that AT&T had shown, on Attachment 5 of its Initial Brief, that 9,000 feet was the

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[1] New York Telephone's Initial Brief, pp. 90-91, citing, with respect to the last item, Tr. 2,900-2,905 and Exhibit 150. Exhibit 150 is an excerpt from the deposition of Hatfield consultant John Donovan in a Texas Utility Commission proceeding in which he stated that "copper is widely perceived by many including myself as a technology that will become obsolete in the near future." In response to the next question, inquiring whether his feeder fill factor was "related to the fact that you don't anticipate installing copper for the future," he responded "in the distant future, that's correct."

[2] AT&T's Reply Brief, p. 98.

appropriate crossover point; that the announced construction plans of potential market entrants is irrelevant to New York Telephone's obligation to prove that its cost study uses the least cost forward-looking technology to provide basic narrowband service; that the context of Mr. Donovan's Texas testimony belies the assertion that he believed copper was no longer useful as a feeder technology and that Mr. Donovan himself was responsible for the 9,000 foot crossover point; that New York Telephone had not provided any analysis of lifetime costs for any crossover point; and that cross-examination of New York Telephone's witness Gansert "demonstrated unequivocally that [New York Telephone's] zero copper feeder policy was implemented five years ago as part of [New York Telephone's] forward-looking business strategy to accommodate broadband services over broadband technologies."[1]

Time Warner challenges the Hatfield assumption that cable and wire facilities are 65% aerial in the highest density zone, which includes Manhattan. The proponents do not directly respond.

ii. Prices

New York Telephone maintains that the switching investment curve used by the Hatfield Model to determine a switch price at a given wire center, which suggests a continuous, inverse relationship between switch size and per-line switch costs, lacks any foundation in reality and is based upon three indefensible data points. It suggests the data underlying the first two points are stale, dating from 1993, and that the third

[1] AT&T's Reply Brief, pp. 99-100, citing Tr. 3,304-3,305. AT&T overstates its reliance on this cross-examination. A better reading of the record appears to be that New York Telephone unequivocally was embarking on the installation of a network with broadband capability; that fiber was part of that network; that copper remained technologically suitable for narrowband feeders; but that New York Telephone took the position that even for narrowband purposes, fiber was economically superior to copper and that the move to fiber would have been made even without regard to the interest in broadband capability.